REMARKS

Claim 5 Rejection based upon Nagai in view of Wakamatsu

Claim 5 was rejected under 35 U.S.C. § 103 as unpatentable over PCT Patent Application Publication WO 01/17048, in view of United States Patent No. 6,231,053, issued to Wakamatsu in 2001. For purposes of this response, reference is made to United States Patent No. 6,720,103, issued to Nagai in 2004.

Claim 5 includes 4 significant features of Applicants' invention. The gasket in Applicants' fuel cell assembly is formed of sheet metal elements. The gasket in Applicants' assembly includes a pillow structure. The pillow structure defines a gas-filled chamber. And the pillow structure is bonded to the adjacent components to form a sealed joint. The prior art does not show a gasket in a fuel cell having these features.

Nadia provides an arrangement that is formed of elastic resin gasket sheet 6 and 7 in Fig. 2, col. 3, lines 29-30. The sheets are composed of polyester, polyamide, polyimide, and polyethylene naphtalate, col. 4, lines 49-51. A stainless steel spacer sheet is interposed between the sheets, col. 4, lines 57-58. The spacer 5a is a critical component of Nadia necessary to maintain a constant distance between the separators 2 and 3, col. 4, lines 34-40. The spacer region does not seal the gap between the adjacent components. Rather, sealing in Nadia is provided by gaskets 8 and 9, which are formed of cured rubber and are located apart from spacer 5a, col. 3, lines 41-49.

The rejection points to the empty spaces to the sides of the spacer 5a in Nadia. However, the critical spacer component defines the gap between the adjacent components and is formed of solid metal. Because of the metal spacer, the air spaces are nonfunctional, and the overall structure is designed to maintain the separation between the adjacent components, and so essentially unyielding, with the noted exception of the compliance provided by the polymer sheets themselves as discussed herein. That is, the structure is hard and is neither soft nor compressible nor any other property attributable to a pillow. Thus, the Nadia structure cannot be fairly characterized as a pillow corresponding to the structure in Applicants' invention.

Further, Nadia describes a gasket formed of polymeric sheets, whereas Applicants' gasket is formed of metal sheets. The rejection points to Wakamatsu to show a gasket having a metal sheet. Wakamatsu describes a gasket 1 that comprises a frame 2 that may be formed of metal, col. 3, line 47. Frame 2 is covered by sealant 6 composed of elastomeric material, preferably a liquid rubber vulcanizate, col. 3, lines 62, to col. 4, line 17. Thus, the gasket in Wakamatsu comprises metal bounded by elastomeric material and is like Nadia in this regard.

More significantly, the assemblies in both Nadia and Wakamatsu require the elastomeric material between the metal and the adjacent components. The fuel cell assembly comprises a stack of cells that are fastened together. The fastener applies a load in a direction perpendicular to the cells, i.e., across the gap where the gasket is located, shown in Nadia Fig. 2, or in Applicants' Fig. 4. The fuel cells operate at elevated

temperatures, and as the temperature increases, differences in thermal expansion of the materials varies the load across the gap. If the sheets in Nadia were replaced with metal, the gap would be bridged by solid metal. Differential expansion of the metal relative to the other components would increase the load and potentially damage the adjacent components. Thus, Nadia requires a compliant material between the metal and the adjacent components to compress, first to allow the initial load to be applied in forming a tight seal, and second to compensate for variations in the load during operation. It is significant that Nadia includes gaskets 8 and 9 to provide the necessary sealing at a location apart from the spacer to allow greater compression of the compliant material without the risk of damage due to the spacer.

Applicants' invention is uniquely able to avoid the problems of a solid metal spacer across the gap, such as would result from replacement of the polymer sheets in Nadia with metal, and to eliminate polymeric materials that tend to degrade at the elevated operating temperature of the fuel cell. (In this regard, Applicants' assembly is adapted for higher operating temperatures than polymeric gaskets.) This is accomplished by a pillow structure that includes a gas-filled chamber. At higher temperatures, the gas pressure increases to maintain sealing contact with the adjacent components. Also, the pillow structure is bonded to the adjacent components. The combination of the gas-filled chamber and the diffusion bonding creates a hermetic seal that is able to withstand the high temperature excursions experienced by the assembly during operation.

Claim 5 is directed to Applicants' fuel cell assembly that includes a gasket formed

of sheet metal elements. The skilled practitioner, aware of the potential for damage in initially applying a load when fastening the cells and also the risk of damage caused by variations in load at operating temperatures, is not lead to replace the elastomeric sheet in Nadia with metal and create a solid metal block across the gap without any compliant member. Wakamatsu also relies on elastomeric material covering the frame, and so does not point the practitioner to eliminate the polymer in Nadia. Claim 5 calls for a pillow structure, as disclosed by Applicants, and which, like a gas spring, compensates for the load to prevent damage to the adjacent components. Because of the spacer, Nadia does not have a pillow structure, and nothing in Nadia would suggest to eliminate the metal spacer to allow the space to act as a pillow structure. Wakamatsu does not have a gas-filled chamber within the gasket, and so does not have a pillow structure as called for in claim 5. Still further, claim 5 recites that the sheet metal elements are diffusion bonded to the components to form a sealed joint. The sheets in Nadia are not bonded to the adjacent components, and the seal is formed at the gaskets 8 and 9, not at the location of the spacer 5a. Nor does Wakamatsu show the gasket bonded to the adjacent components.

For these reasons, the practitioner, aware of Nadia and Wakamatsu, is not lead to Applicants' fuel cell assembly in claim 5.

Accordingly, it is respectfully requested that the rejection of the claim 5 based upon Nagai and Wakamatsu, be reconsidered and withdrawn, and that the claim be allowed.

Claim Rejection based upon Nagai in view of JP '783

Claim 5 was rejected under 35 U.S.C. § 103 as unpatentable over Nadia in view of Japanese patent publication 06-96783, referred to as JP '783.

The rejection refers to the Abstract of JP '783, but did not include an English translation thereof. In the discussion herein, reference is made to an English translation of JP '783 obtained from the database of the Patent Abstracts of Japan, a copy of which is enclosed.

For all the reasons set forth above, because of the metal spacer, Nadia does not show a pillow structure, does not suggest to replace the compliant polymer sheets with hard metal, does not bond the spacer region to the adjacent components, and so does not show Applicants' invention in claim 5.

JP '783 discloses a gasket 21 formed of a silicone sheet, Example 1, paragraph 0012 (although the translation reads "silicon," the practitioner would understand that silicone was intended). Example 2 describes foam rubber sheets about a metal sheet, paragraph 0013. Thus, JP '783, like Nadia, forms a gasket with non-metallic material in contact with the adjacent components. Even if combined, JP '783 does not lead the practitioner to replace the polymer sheets with metal sheets. Moreover, JP '783 uses a metal sheet embedded in the foam rubber. Thus, Nadia does not lead the practitioner to eliminate the metal spacer from Nadia to form a pillow structure, as in Applicants'

invention. Still further, neither JP '783 nor Nadia bond the gasket, or more particularly, the metal sheet within the gasket, to the adjacent components. Thus, the references do not point to a pillow structure formed in a metal sheet and bonded to the adjacent components to form a seal, in accordance with Applicants' invention as recited in claim 5.

Accordingly, it is respectfully requested that the rejection of the claim 5 based upon Nagai and JP '783, be reconsidered and withdrawn, and that the claim be allowed.

Claim Rejection based upon Nagai in view of Franklin et al.

Claim 5 was rejected under 35 U.S.C. § 103 as unpatentable over Nadia in view of United States Patent Application Publication US 2004/0053099, by Franklin et al. .

For all the reasons set forth above, the metal spacer embedded in the polymer sheets in Nadia does not suggest a pillow structure, or to replace the compliant polymer sheets with hard metal, or to bond the spacer region to the adjacent components, and so does not show Applicants' invention in claim 5.

Franklin et al. is applied to show a gasket for a fuel cell that includes a plastic polymer material, an elastomeric material, a composite material, a metallic material, a foam material or combinations thereof. However, Franklin et al. does not point the practitioner to eliminate the spacer in Nadia. Nor does Franklin et al. point the

practitioner to replace the compliant polymer sheets in Nadia with metal sheets so as to form a solid and unyielding metal support within the gap. Nor does Franklin et al. point the practitioner to bond the spacer region in Nadia to the adjacent components, instead of using the remote gaskets provided by Nadia for the purpose of sealing the gap. Thus, even if combined, the references do not suggest Applicants' invention as set forth in claim 5.

Accordingly, it is respectfully requested that the rejection of the claim 5 based upon Nagai and Franklin et al., be reconsidered and withdrawn, and that the claim be allowed.

Rejection of Claims 6 and 7

Claims 6 and 7 were rejected under 35 U.S.C. § 103 as unpatentable over Nadia in view of Wakamatsu, or JP '783 or the combination of Franklin et al. and United States Patent Application Publication No. US2004/0150162, by Inagaki et al.

Claims 6 and 7 are dependent upon claim 5. For all the reasons set forth above, the Nadia structure with the metal spacer within the polymer sheets does not suggest a pillow structure, does not lead the practitioner eliminate the compliant polymer and form a solid metal support, and does not bond the spacer region to the adjacent components to form a seal, and so does not show Applicants' invention in claim 5.

Also for the reasons set forth herein, Wakamatsu et al., JP '783, and Franklin et al. do not lead the practitioner to eliminate the spacer in Nadia, replace the polymer sheets with metal sheets, bond the metal sheets to the adjacent components, and eliminate the gaskets shown in Nadia. Without this, Nadia and the secondary references do not suggest Applicants' invention in claim 5.

Inagaki et al. is applied to disclose a seal in a fuel cell for a vehicle. However, as discussed previously by Applicants in their prior response, Inagaki et al. does not show a gasket formed of metal sheets and including a gas-filled pillow structure that is diffusion bonded to the adjacent components, and so does not make up the short comings of Nadia.

Thus, the combined references do not suggest Applicants' fuel cell assembly in claim 5. It follows then that they cannot show the fuel cell assembly in claims 6 and 7 dependent upon claim 5.

Accordingly, it is respectfully requested that the rejection of the claims 6 and 7 be reconsidered and withdrawn, and that the claims be allowed.

Conclusion

If it would further prosecution of the application, the Examiner is urged to contact the undersigned at the phone number provided.

The Commissioner is hereby authorized to charge any fees associated with this communication to Deposit Account No. 50-0831.

Respectfully submitted,

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PATENT ABSTRACTS OF JAPAN

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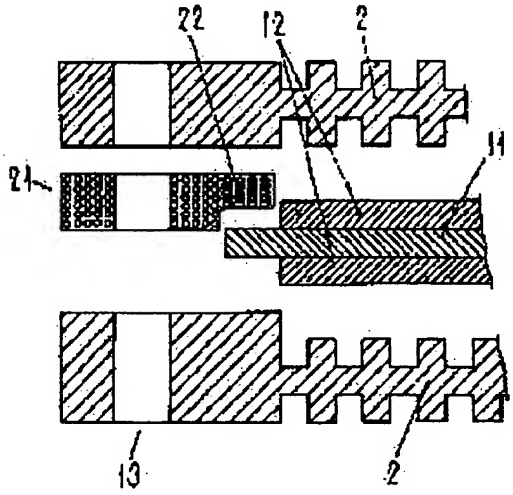
EDA NOBUO

(54) FUEL CELL



(57)Abstract:
PURPOSE: To reduce size and weight, and improve economic property by using a gasket exhibiting high sealing property with low fastening pressure.
CONSTITUTION: A gasket 21 is formed of a sponge sheet of independent bubbles 22, or formed into an integrated structure in which the sponge sheet of the bubbles 22 is adhered to both surface of a metal base. The gasket 21 is further formed into an integrated structure in which a rubber sheet is adhered to both surfaces of the metal base, and the periphery of its sealing part is subjected to protruding embossing finish. Since the sponge sheet of the bubbles 22 absorbs the thickness of an ion-exchange film 11 or the irregularities of a separator plate 2 by the compression of the bubbles 22, excellent sealing property can be provided with a small fastening pressure. Further, since the sponge sheet of the bubbles 22 is adhered to the metal base, the sponge sheet never escape to the outside by the adhesive force when a high pressure gas is used in the inner part, so that a highly precise working can be performed, and a linear seal can be also performed. Thus, a fuel cell can be reduced in size and weight, and economic property can be improved.

LEGAL STATUS
[Date of request for examination] 31.03.1998
[Date of sending the examiner's decision of 09.01.2001

* NOTICES *

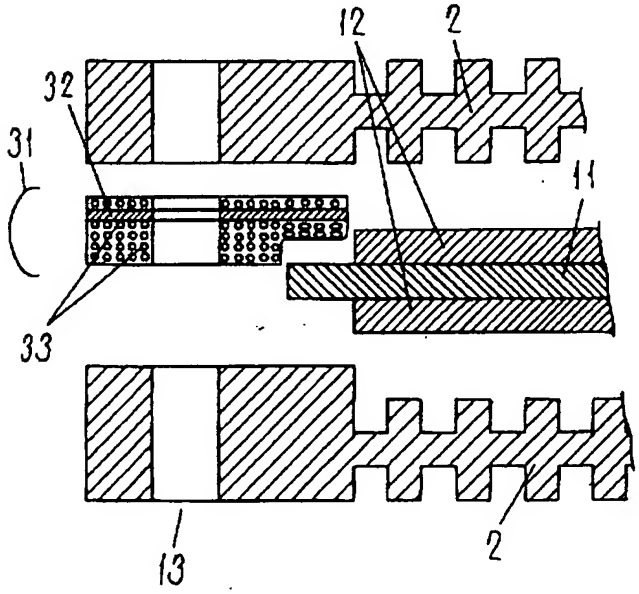
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The fuel cell with which a gasket consists of a sponge sheet of a closed cell in the fuel cell by which arranged the gasket on the periphery of the unit cell which consists of a positive electrode, an electrolyte plate, and a negative electrode, and the laminating was carried out through the separator plate.
[Claim 2] The fuel cell with which a gasket consists of integral construction which pasted up the sponge sheet of a closed cell on both sides of a metal substrate in the fuel cell by which arranged the gasket on the periphery of the unit cell which consists of a positive electrode, an electrolyte plate, and a negative electrode, and the laminating was carried out through the separator plate.
[Claim 3] The fuel cell which a gasket is arranged on the periphery of the unit cell which consists of a positive electrode, an electrolyte plate, and a negative electrode, and a gasket consists of integral construction which pasted up the rubber sheet on both sides of a metal substrate in the fuel cell by which the laminating was carried out through the separator plate, and comes to give crest-like embossing on the outskirts of the seal section of a gasket.
[Claim 4] The fuel cell whose gasket is claim 1, claim 2, or claim 3 in the fuel cell by which arranged the gasket on the periphery of the ion exchange membrane which consists of a solid-state macromolecule, and the unit cell which consists of the positive electrode and negative electrode which have an electrode catalyst bed to both sides which touch this ion exchange membrane, and the laminating was carried out through the separator plate.

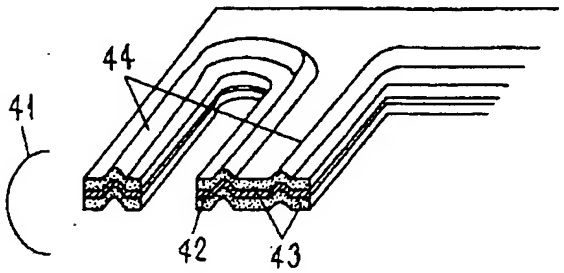
[Translation done.]

Drawing selection Representative drawing



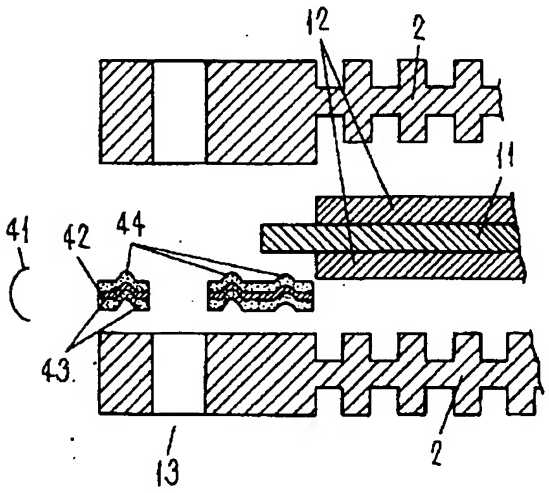
[Translation done.]

Drawing selection drawing 3



[Translation done.]

Drawing selection drawing 4



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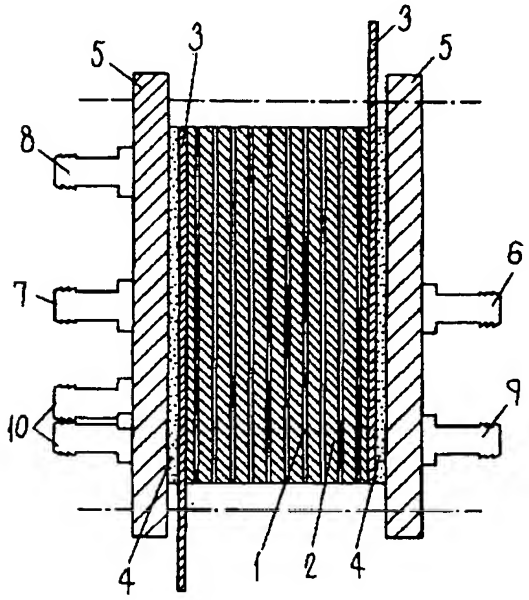
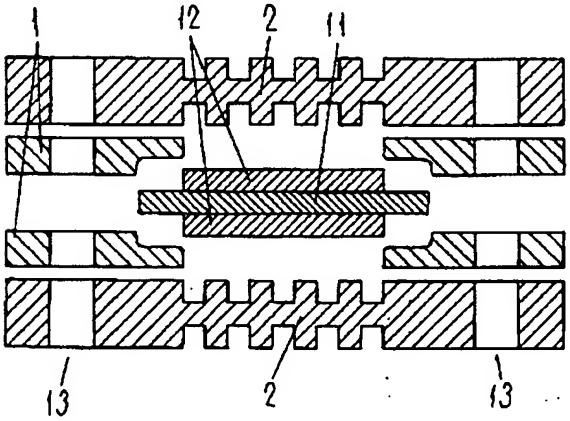
Drawing selection drawing 5



[Translation done.]

Drawing selection drawing 6



[Translation done.]

rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

EFFECT OF THE INVENTION

[Effect of the Invention] As for this invention, in a fuel cell, a gasket should consist of a sponge sheet of a closed cell as mentioned above. Moreover, consist of a gasket of the integral construction which pasted up the sponge sheet of a closed cell on both sides of a metal substrate. Furthermore, the gasket consisted of integral construction which pasted up the rubber sheet on both sides of a metal substrate, and it considered as the configuration which performs crest-like embossing on the outskirts of the seal section of said gasket. Thereby, with the first configuration, since the sponge sheet of a closed cell absorbs the thickness of ion exchange membrane, and the irregularity of a separator plate by compression of air bubbles, the small seal engine performance which bound tight and was excellent in ** is realizable. With the second configuration, since the sponge sheet of a closed cell has pasted the metal substrate, also when high-pressure gas is used for the interior, a sponge sheet does not escape outside by adhesive strength. Since the metal plate is used as a substrate, high processing of precision is possible. With the third configuration, the same linear seal as an O ring becomes possible by embossing of the shape of a crest of the seal section circumference.

[0018] It becomes possible to change to what could reduce the reinforcement of an end plate, a separator, an electrode, etc. since it bound tight and sharp reduction of a pressure was realized according to the above effectiveness, for example, was using stainless steel conventionally as an end plate, and to use ingredients, such as engineer plastics, and it is small and lightweight and the high fuel cell of economical efficiency can be realized.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the gasket of a solid-state polyelectrolyte mold fuel cell especially about the fuel cell which uses air and oxygen as an oxidizer, using reducing agents, such as pure hydrogen or a methanol, and reforming hydrogen from a fossil fuel, as a fuel.
[0002]
[Description of the Prior Art] For example, when a solid-state polyelectrolyte mold fuel cell introduces oxygen into a solid-state polyelectrolyte by using hydrogen as an oxidizer as a fuel using the cation exchange membrane which is a proton conductor, it is known that the next reaction will occur.
[0003]
(** 1) Negative electrode H2 -> 2H+ +2e- (** 2) Positive electrode 1 / 2O2 +2H+ +2e- -> In an H2O negative electrode, hydrogen dissociates into a proton and an electron. A proton moves toward a positive electrode in the inside of cation exchange membrane, and an electron moves further in an external circuit with the cel by which the laminating was carried out to the conductive separator plate and the serial, and results in a positive electrode. A generation of electrical energy is performed at this time. On the other hand, in a positive electrode, the proton which has moved in the inside of cation exchange membrane, the electron which has moved in the external circuit, and the oxygen introduced from the outside react, and water is generated. Since this reaction is accompanied by generation of heat, it generates the electrical and electric equipment, water, and heat from hydrogen and oxygen as a whole.
[0004] The point that a solid-state polyelectrolyte mold fuel cell differs from other fuel cells greatly is a point which consists of ion exchange membrane whose electrolytes are solid-state macromolecules. Although the perfluorocarbon-sulfonic-acid film (made in [Du Pont] the U.S., trade name Nafion) etc. is used for this ion exchange membrane, in order to show proton conductivity with this sufficient film, the film fully needs to hydrate. The approach of introducing a steam in a cel and preventing desiccation of ion exchange membrane is taken by letting reactant gas pass in a humidifier as the approach of carrying out hydration of the ion exchange membrane, as indicated by J.Electorochem.Soc.135 (1988) 2209, for example. Moreover, as an approach of carrying out the seal of each cel, it is J.Power, for example. Area of ion exchange membrane is

made larger than an electrode surface product, and the approach of putting the perimeter part which is not joined to the electrode of ion exchange membrane with an up-and-down gasket is taken as indicated by Sources and 29 (1990) 367. The glass tissue and fluorine rubber which coated polytetrafluoroethylene (made in [Du Pont] the U.S., trade name Teflon) as the quality of the material of a gasket are used. Moreover, silicone rubber and fluorine rubber are used in United States patent No.4,826,741. A gasket must perform the insulation between ****** separator plates, and a gas seal at the time of this configuration, absorbing the thickness of about 150-200-micrometer ion exchange membrane. Then, detailed processing which makes thin thickness of the part equivalent to which the draw-down pressure of a cel is greatly carried out, a gasket is crushed or the ion exchange membrane of a gasket is by thickness was required.

[0005]

[Problem(s) to be Solved by the Invention] However, by the above-mentioned conventional approach, since the thickness of the ion exchange membrane which should be absorbed as the number of laminatings of a cel increases is integrated and it becomes large, it becomes impossible to be unable to absorb, it binds tight and ** is needed, and in order [being very big] to secure reinforcement, other housing, such as an end plate and a bolt nut, will become large-scale. Moreover, it had the fault without sufficient gas-seal nature securable [with dispersion in the thickness of a gasket, ion exchange membrane, or a separator plate]. Furthermore, since thickness changed with change of water content, since stress relaxation nature was large, ion exchange membrane had risk of saying that the seal nature secured at the beginning is in the middle of operation, and falls with the conventional gasket ingredient.

[0006] It aims at offering the lighter high fuel cell of economical efficiency, especially a solid-state polyelectrolyte mold fuel cell by this invention's solving the above-mentioned conventional technical problem, and using the low gasket which binds tight and demonstrates high seal nature by the pressure.

[0007]

[Means for Solving the Problem] In order to attain this purpose, according to this invention, arrange a gasket on the periphery of the unit cell which consists of a positive electrode, an electrolyte plate, and a negative electrode, and a gasket should consist of a sponge sheet of a closed cell in the fuel cell by which the laminating was carried out through the separator plate. Moreover, consist of a gasket of the integral construction which pasted up the sponge sheet of a closed cell on both sides of a metal substrate. Furthermore, a gasket consists of integral construction which pasted up the rubber sheet on both sides of a metal substrate, and it considers as the configuration which performs crest-like embossing on the outskirts of the sheet section of said gasket.

[0008]

[Function] With this first configuration, the sponge sheet of a closed cell absorbs the thickness of ion exchange membrane by compression of air bubbles. Moreover, in order that the air bubbles with which each became independent also to partial irregularity may compress, the swell and granularity of a separator plate are also absorbable. Furthermore, since the sealed air bubbles are made to compress, stress relaxation is small. With the second configuration, since the sponge sheet of a closed cell has pasted the metal substrate, also when high-pressure gas is used for the interior, a sponge sheet does not escape outside by the adhesive strength of a substrate and a sheet. Since the metal plate is

used as a substrate, high processing of precision is possible. For example, when an aluminum plate etc. is used for a substrate, punching processing with the Thompson mold is also easy. With the third configuration, the same linear seal as an O ring becomes possible by embossing of the shape of a crest of the seal section circumference.
[0009]
[Example] Hereafter, the example of this invention is explained, referring to a drawing.
[0010] Drawing 5 is the external view of the layer built cell of a general solid-state polyelectrolyte mold fuel cell. The separator plate 2 which consists of conductive materials, such as glassy carbon, and the insulating gasket 1 are accumulated by turns, and it is stuck to the copper collecting electrode plate 3 by the outermost separator plate. It has structure which sandwiches this layered product with the end plate 5 made from stainless steel through an electric insulating plate 4, and binds between end plates tight with a bolt and a nut. Of course, the quality of the material of each parts will not be limited to the above-mentioned material, if conditions, such as conductivity, insulation, thermal resistance, and gas permeability, do not have ****** in the cell engine performance in a bad influence.
[0011] Drawing 6 is drawing having shown the sectional view of the general interior cel of a layer built cell. An electrode 12 is joined by both sides of the central ion exchange membrane 11, and the separator plate 2 up and down with a slot of the zygote is located. The area of ion exchange membrane is larger than an electrode, inserts a perimeter with a gasket, and is performing the insulation between the seal of each cel, and separator plates. As shown in drawing, in installing a gas passageway 13 in the interior of a layered product if needed (internal manifold mold), a gasket also performs the seal of this gas passageway. Using the case where the separator plate with a slot inserts a porous plate with a slot in the part of a slot, a mesh, etc., various structures are possible and this structure does not limit this invention.
[0012] (Example 1) Drawing 1 showed the cross section of the cel of the example 1 of this invention. The sponge sheet of the closed cell of silicon with a thickness of 1.0mm was used for the gasket 21 by the product made from Kureha rubber industry. The seal of both between ion exchange membrane and a separator was able to be performed between separator plates, absorbing the thickness of ion exchange membrane 11, when the air bubbles 22 with which the part which touches ion exchange membrane became independent compress further rather than the part pinched by separator plate 2 in the case of the gasket of this invention. In the case of the gasket of this invention, 3kg/cm2 or more of a draw-down pressure was enough to the case where a fluororubber without the conventional air bubbles was used having needed 10kg/cm2 of seal **.
[0013] (Example 2) Drawing 2 showed the cross section of the cel of the example 2 of this invention. The foam rubber sheet (a trade name, meta-form) by NICHIAS CORP. was used for the gasket 31. This gasket pasted up the sponge rubber 33 of the closed cell of a butadiene and acrylonitrile rubber on both sides of the aluminum plate 32 with a thickness [of a substrate] of 0.25mm, and made it the thickness of 1.5mm as a whole. 2kg/cm2 or more was enough as seal ** by the same seal effectiveness as an example 1. Furthermore, neither with the conventional gasket made of a fluororubber, nor the sponge sheet of an example 1, when the internal pressure of a cel and a gas passageway turned into high pressure, to the gasket having shifted outside, and having been blown and turned off, in the case of the gasket of an example 2, the gap of a rubber layer was

prevented by the adhesive strength of an aluminum plate, and a butadiene and an acrylonitrile rubber layer, it blew by it, and a piece was raised to it.
[0014] (Example 3) Drawing 3 and drawing 4 showed the cross-section perspective view of the gasket of the example 3 of this invention, and the cross section of a cel, respectively. The metal and the rubber compound gasket by NICHIAS CORP. (a trade name, meta-coat) were used for the gasket. This gasket 41 pasted up nitrile rubber 43 on both sides of the griddle 42 with a thickness [of a substrate] of 0.25mm, made it the thickness of 0.38mm as a whole, and performed crest-like embossing 44 around the periphery of an electrode, and the gas supply hole. Since embossing of an electrode periphery put the ion exchange membrane, it set up the height of embossing a little small. The same linear seal as an O ring became possible by embossing of the shape of a crest of this seal section circumference, and 6kg/cm2 or more was enough as seal **.
[0015] In addition, although the aforementioned quality of the material was used as an ingredient of a gasket in this example, since operating temperature is 120 degrees C or less, and this solid-state polyelectrolyte mold fuel cell can use various spring materials and does not use the corrosive electrolytic solution, it does not need special chemical resistance, either. Therefore, if the thermal resistance of 120 degrees C is secured, it will be possible to choose what kind of the quality of the material, and this invention will not be limited to the ingredient of an example.
[0016] Furthermore, although this example showed how to carry out a seal from the one direction of ion exchange membrane, using a gasket one sheet, the same effectiveness was acquired even if it took the approach of putting two ion exchange membrane using a gasket. Moreover, although the example described the solid-state polyelectrolyte mold fuel cell as an example, the same effectiveness as a phosphoric acid fuel cell, alkaline fuel cells, etc. was shown.
[0017]
[Effect of the Invention] As for this invention, in a fuel cell, a gasket should consist of a sponge sheet of a closed cell as mentioned above. Moreover, consist of a gasket of the integral construction which pasted up the sponge sheet of a closed cell on both sides of a metal substrate. Furthermore, the gasket consisted of integral construction which pasted up the rubber sheet on both sides of a metal substrate, and it considered as the configuration which performs crest-like embossing on the outskirts of the seal section of said gasket. Thereby, with the first configuration, since the sponge sheet of a closed cell absorbs the thickness of ion exchange membrane, and the irregularity of a separator plate by compression of air bubbles, the small seal engine performance which bound tight and was excellent in ** is realizable. With the second configuration, since the sponge sheet of a closed cell has pasted the metal substrate, also when high-pressure gas is used for the interior, a sponge sheet does not escape outside by adhesive strength. Since the metal plate is used as a substrate, high processing of precision is possible. With the third configuration, the same linear seal as an O ring becomes possible by embossing of the shape of a crest of the seal section circumference.
[0018] It becomes possible to change to what could reduce the reinforcement of an end plate, a separator, an electrode, etc. since it bound tight and sharp reduction of a pressure was realized according to the above effectiveness, for example, was using stainless steel conventionally as an end plate, and to use ingredients, such as engineer plastics, and it is small and lightweight and the high fuel cell of economical efficiency can be realized.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the gasket of a solid-state polyelectrolyte mold fuel cell especially about the fuel cell which uses air and oxygen as an oxidizer, using reducing agents, such as pure hydrogen or a methanol, and reforming hydrogen from a fossil fuel, as a fuel.

[Translation done.]done.]
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EFFECT OF THE INVENTION

[Effect of the Invention] As for this invention, in a fuel cell, a gasket should consist of a sponge sheet of a closed cell as mentioned above. Moreover, consist of a gasket of the integral construction which pasted up the sponge sheet of a closed cell on both sides of a metal substrate. Furthermore, the gasket consisted of integral construction which pasted up the rubber sheet on both sides of a metal substrate, and it considered as the configuration which performs crest-like embossing on the outskirts of the seal section of said gasket. Thereby, with the first configuration, since the sponge sheet of a closed cell absorbs the thickness of ion exchange membrane, and the irregularity of a separator plate by compression of air bubbles, the small seal engine performance which bound tight and was excellent in ** is realizable. With the second configuration, since the sponge sheet of a closed cell has pasted the metal substrate, also when high-pressure gas is used for the interior, a sponge sheet does not escape outside by adhesive strength. Since the metal plate is used as a substrate, high processing of precision is possible. With the third configuration, the same linear seal as an O ring becomes possible by embossing of the shape of a crest of the seal section circumference.

[0018] It becomes possible to change to what could reduce the reinforcement of an end plate, a separator, an electrode, etc. since it bound tight and sharp reduction of a pressure was realized according to the above effectiveness, for example, was using stainless steel conventionally as an end plate, and to use ingredients, such as engineer plastics, and it is small and lightweight and the high fuel cell of economical efficiency can be realized.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, by the above-mentioned conventional approach, since the thickness of the ion exchange membrane which should be absorbed as the number of laminatings of a cel increases is integrated and it becomes large, it becomes impossible to be unable to absorb, it binds tight and ** is needed, and in order [being very big] to secure reinforcement, other housing, such as an end plate and a bolt nut, will become large-scale. Moreover, it had the fault without sufficient gas-seal nature securable [with dispersion in the thickness of a gasket, ion exchange membrane, or a separator plate]. Furthermore, since thickness changed with change of water content, since stress relaxation nature was large, ion exchange membrane had risk of saying that the seal nature secured at the beginning is in the middle of operation, and falls with the

conventional gasket ingredient.
[0006] It aims at offering the lighter high fuel cell of economical efficiency, especially a solid-state polyelectrolyte mold fuel cell by this invention's solving the above-mentioned conventional technical problem, and using the low gasket which binds tight and demonstrates high seal nature by the pressure.

OPERATION

[Function] With this first configuration, the sponge sheet of a closed cell absorbs the thickness of ion exchange membrane by compression of air bubbles. Moreover, in order that the air bubbles with which each became independent also to partial irregularity may compress, the swell and granularity of a separator plate are also absorbable. Furthermore, since the sealed air bubbles are made to compress, stress relaxation is small. With the second configuration, since the sponge sheet of a closed cell has pasted the metal substrate, also when high-pressure gas is used for the interior, a sponge sheet does not escape outside by the adhesive strength of a substrate and a sheet. Since the metal plate is used as a substrate, high processing of precision is possible. For example, when an aluminum plate etc. is used for a substrate, punching processing with the Thompson mold is also easy. With the third configuration, the same linear seal as an O ring becomes possible by embossing of the shape of a crest of the seal section circumference.

EXAMPLE

[Example] Hereafter, the example of this invention is explained, referring to a drawing.
[0010] Drawing 5 is the external view of the layer built cell of a general solid-state polyelectrolyte mold fuel cell. The separator plate 2 which consists of conductive

materials, such as glassy carbon, and the insulating gasket 1 are accumulated by turns, and it is stuck to the copper collecting electrode plate 3 by the outermost separator plate. It has structure which sandwiches this layered product with the end plate 5 made from stainless steel through an electric insulating plate 4, and binds between end plates tight with a bolt and a nut. Of course, the quality of the material of each parts will not be limited to the above-mentioned material, if conditions, such as conductivity, insulation, thermal resistance, and gas permeability, do not have ****** in the cell engine performance in a bad influence.

[0011] Drawing 6 is drawing having shown the sectional view of the general interior cel of a layer built cell. An electrode 12 is joined by both sides of the central ion exchange membrane 11, and the separator plate 2 up and down with a slot of the zygote is located. The area of ion exchange membrane is larger than an electrode, inserts a perimeter with a gasket, and is performing the insulation between the seal of each cel, and separator plates. As shown in drawing, in installing a gas passageway 13 in the interior of a layered product if needed (internal manifold mold), a gasket also performs the seal of this gas passageway. Using the case where the separator plate with a slot inserts a porous plate with a slot in the part of a slot, a mesh, etc., various structures are possible and this structure does not limit this invention.

[0012] (Example 1) Drawing 1 showed the cross section of the cel of the example 1 of this invention. The sponge sheet of the closed cell of silicon with a thickness of 1.0mm was used for the gasket 21 by the product made from Kureha rubber industry. The seal of both between ion exchange membrane and a separator was able to be performed between separator plates, absorbing the thickness of ion exchange membrane 11, when the air bubbles 22 with which the part which touches ion exchange membrane became independent compress further rather than the part pinched by separator plate 2 in the case of the gasket of this invention. In the case of the gasket of this invention, 3kg/cm2 or more of a draw-down pressure was enough to the case where a fluororubber without the conventional air bubbles was used having needed 10kg/cm2 of seal **.

[0013] (Example 2) Drawing 2 showed the cross section of the cel of the example 2 of this invention. The foam rubber sheet (a trade name, meta-form) by NICHIAS CORP. was used for the gasket 31. This gasket pasted up the sponge rubber 33 of the closed cell of a butadiene and acrylonitrile rubber on both sides of the aluminum plate 32 with a thickness [of a substrate] of 0.25mm, and made it the thickness of 1.5mm as a whole. 2kg/cm2 or more was enough as seal ** by the same seal effectiveness as an example 1. Furthermore, neither with the conventional gasket made of a fluororubber, nor the sponge sheet of an example 1, when the internal pressure of a cel and a gas passageway turned into high pressure, to the gasket having shifted outside, and having been blown and turned off, in the case of the gasket of an example 2, the gap of a rubber layer was prevented by the adhesive strength of an aluminum plate, and a butadiene and an acrylonitrile rubber layer, it blew by it, and a piece was raised to it.

[0014] (Example 3) Drawing 3 and drawing 4 showed the cross-section perspective view of the gasket of the example 3 of this invention, and the cross section of a cel, respectively. The metal and the rubber compound gasket by NICHIAS CORP. (a trade name, meta-coat) were used for the gasket. This gasket 41 pasted up nitrile rubber 43 on both sides of the griddle 42 with a thickness [of a substrate] of 0.25mm, made it the thickness of 0.38mm as a whole, and performed crest-like embossing 44 around the

periphery of an electrode, and the gas supply hole. Since embossing of an electrode periphery put the ion exchange membrane, it set up the height of embossing a little small. The same linear seal as an O ring became possible by embossing of the shape of a crest of this seal section circumference, and 6kg/cm2 or more was enough as seal **.

[0015] In addition, although the aforementioned quality of the material was used as an ingredient of a gasket in this example, since operating temperature is 120 degrees C or less, and this solid-state polyelectrolyte mold fuel cell can use various spring materials and does not use the corrosive electrolytic solution, it does not need special chemical resistance, either. Therefore, if the thermal resistance of 120 degrees C is secured, it will be possible to choose what kind of the quality of the material, and this invention will not be limited to the ingredient of an example.

[0016] Furthermore, although this example showed how to carry out a seal from the one direction of ion exchange membrane, using a gasket one sheet, the same effectiveness was acquired even if it took the approach of putting two ion exchange membrane using a gasket. Moreover, although the example described the solid-state polyelectrolyte mold fuel cell as an example, the same effectiveness as a phosphoric acid fuel cell, alkaline fuel cells, etc. was shown.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The sectional view of the cel in the example 1 of this invention

[Drawing 2] The sectional view of the cel in the example 2 of this invention

[Drawing 3] The cross-section perspective view of the gasket in the example 3 of this invention

[Drawing 4] The sectional view of the cel in the example 3 of this invention

[Drawing 5] The external view of a general solid-state polyelectrolyte mold fuel cell

[Drawing 6] The sectional view of a general cel

[Description of Notations]

1 Gasket
2 Separator Plate
3 Collecting Electrode Plate
4 Electric Insulating Plate
5 End Plate
6 Hydrogen Inlet Port
7 Hydrogen Outlet

8 Oxygen Inlet Port
9 Oxygen Outlet
10 Wastewater Drain
11 Ion Exchange Membrane
12 Electrode
13 Gas Passageway
21 Gasket of Example 1
31 Gasket of Example 2
32 Aluminum Plate
33 Sponge Rubber Layer
41 Gasket of Example 3
42 Griddle
43 Rubber Layer
44 Embossing

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JAPANESE [JP,06-096783,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

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